

More on the Categorical Analysis of Grammatical Relations*

David R. Dowty

0. Introduction

Syntactic and semantic analyses of natural languages produced since the mid 1970's by linguists who adopted Richard Montague's ideas about semantics differed from previous research in three ways: First, this work used a more sophisticated and explicitly-formulated semantic theory. Second, it did not involve a level of "semantic representation" at all but rather what Bach (1980) has termed "rule-to-rule" semantics, that is, each syntactic rule is associated with a semantic rule that directly gives the conditions of truth and denotation of the constituent formed by the syntactic rule. Third, it adopted the methodology of doing syntactic and semantic analysis of each construction simultaneously. By looking at the relationship between syntax and semantics in this new way, researchers were led to ignore the traditional transformational analyses of Passive, Equi, Raising and such rules, and to generate such sentences syntactically in terms of their surface structure alone. (Cf. Partee's "Well-Formedness Constraint," Partee 1979). The resulting theory is radically "monostratal" in every sense of the word: it involves neither multiple levels of syntactic structure on the one hand, nor any levels of "semantic representation", "logical form", etc., on the other.¹ Rather, the syntactic analysis tree of a sentence (the series of steps by which it is put together syntactically) and the semantic rules (which correspond one-for-one to syntactic steps) are the sole determinants of the compositional semantics of a sentence. The most recent widely-known version of such a theory is the Generalized Phrase Structure Grammar (GPSG) of Gazdar (1982) and others, which restricts syntactic rules to context-free PS rules.

In a series of papers (Dowty 1975, 1978, 1982) I have compared these sorts of theories with the claims of universal generalizations about grammatical relations presented in Relational Grammar (Perlmutter and Postal 1977) and proposed tentatively that all important generalizations about grammatical relations can be captured in this monostratal Montague-type analysis. I will very briefly review this approach in §1 and then go on to discuss two issues which it raises: relational-changing rules which apparently apply to more than one grammatical relation (§2) and the distinction between Equi and Raising Verbs and the treatment of "dummy" NPs (§3). Those familiar with (Dowty 1978) or (Dowty 1982) may skip directly to §2, (p. 108).

1. The Categorical Analysis of Grammatical Relation.

In these earlier papers, I proposed essentially that so-called grammatical relations can be adequately treated simply as an artifact of the hierarchical order in which a multi-place verb combines with its various arguments. Following Montague's (1973) lead, I suggest that a multi-place verb of n arguments always be represented as a functor combining with one argument to give a $n-1$ place verb (phrase) as its value; this may be termed the "Montague-Schoenfinkel" principle, after Schoenfinkel (1924) and Montague (1973):

- (1) (Montague-Schoenfinkel principle). A multi-place verb of n arguments is always represented as a functor of one argument that yields a n-1 place verb (phrase) as its value.

By using (1) recursively, it follows that a verb need only combine with one argument at a time, no matter how many arguments it ultimately receives. By this principle, verbs of one, two, and three NP arguments will be assigned to the categories listed in (2):

- (2) Categories of verb/verb phrases:

Symbol	Categorial Definition	Name
IV	S/NP	intransitive VP
TV	IV/NP	transitive VP
TTV	TV/NP	ditransitive VP

Syntactic rules (whose semantic interpretation is functional application) will then combine a NP with any verb on this hierarchy to yield a phrase of the next higher category as output (or in the case of IV, yielding a sentence as output). Of course, other obligatory complements of a verb, such as infinitive VPs, PPs and Adjectives, will also be treated as arguments of a verb in this one-step-at-a-time fashion, but I won't discuss these here. Lest such a hierarchy seem to be an unnecessary complication, note that it does two things which any syntactic and semantic theory must do: (1) it subcategorizes verbs syntactically according to the number of NPs they take and (2) it provides a means for matching the meaning of an NP argument with the proper argument position of the meaning of the verb. The reason for arranging these categories so that each "feeds" the next higher one is that certain NPs are treated alike no matter how many arguments the verb has--for example, the NPs we call subjects are treated alike, in case marking and/or syntactic position, whether the verb is transitive, intransitive or ditransitive. Such a hierarchy predicts this, and we may in fact define grammatical relations in terms of it:

- (3) 1. A subject is any NP combined with an IV to produce a S.
 2. A direct object is any NP combined with a TV to produce an IV.
 3. An indirect object is any NP combined with a TTV to produce a TV.

While these definitions and this hierarchy are putatively language-universal, the actual syntactic operations that combine each kind of VP with its argument are language particular and of course vary from language to language. One language may combine a subject with an IV to produce a S by putting the NP before the verb, another by putting the NP after the verb, yet another by marking the NP with nominative case but perhaps not specifying a fixed order of subject and verb. According to this theoretical definition, therefore, the empirical diagnostic we should use in identifying subjects, direct objects, etc., in any natural language is (4):

- (4) 1. Find NPs which are treated syntactically alike (in terms of case marking, position, and by other syntactic processes) with intransitive, transitive, and ditransitive verbs; these NPs are subjects.
2. Find NPs which are not subjects but are treated alike with transitives and ditransitives; these are direct objects.
3. Find NPs which are not subjects or direct objects (and are treated alike in ditransitives and four-place verbs if any); these are indirect objects.

Of course, languages are not always completely uniform in the way they treat the arguments of one of these verbal categories. German, for example, marks the argument of most of its two-place verbs with accusative case but that of other two-place verbs with dative case, still others with genitive. It will thus sometimes be necessary to distinguish syntactic subcategories of verbs of a given number of arguments for the purpose of case marking. Other syntactic rules may observe this subcategory distinction as well; for example, German two-place verbs that take accusative objects will passivize, but those taking datives will not. To accord with traditional terminology, I will reserve the terms subject and object, transitive and ditransitive to refer to the largest or unmarked class of verbs of each number of argument and make up new terms, if necessary, for the arguments of the exceptional verbs. For example, I will refer to the third NP in (5) as indirect object in English, but the third NP in (6) is not marked with to, even though it occupies the parallel position in the argument hierarchy of the verb, so the verb spare must be put in a distinct subcategory from tell; I will thus call this third NP in (6) a secondary object:

- (5) Mary told the story to John. (John is indirect object; give of category TV/NP_[+to], or DTV)

- (6) Mary spared John the trouble. (the trouble is secondary object; spare of category TV/NP_[-to], or TTV)

Because of this complication, grammatical relations will not always be completely definable in terms of the semantics of the argument hierarchy: the verb's syntactic category (which determines its "grammatical relations" on the syntactic side), to be sure, uniquely determines the type of function it denotes, but the type of function a verb denotes will not quite determine its syntactic category in the case where the language has two or more distinct subcategories for this configuration of arguments. To avoid weakening the explanation of grammatical relations and relation-changing rules (cf. below), I propose we should always ask for independent motivation for such subcategorization. For example, it would be legitimate to appeal to subcategorization of two-place verbs into two classes to explain the lack of passives for some of them only if the language treats this same subclass of two-place verbs differently in some other way as well, for example, in case marking.

Another important distinction for the argument hierarchy theory is between the arguments of a verb (subject, object, indirect object, and other obligatory complements) and modifiers of a verb (in the case of NPs, locatives, benefactives and instrumentals are usually modifiers,

cf. Dowty 1982, 89-90). Modifiers are treated as functors which map a VP into a new VP of the same type, e.g. an IV into an IV.

With the distinction defined this way, the diagnostic for separating arguments from modifiers should be two-fold: whereas modifiers such as locatives, instrumentals and benefactives are compatible (up to the limits of real-world plausibility) with verbs of any number of argument places, the number of true arguments a verb takes is fixed by the lexical meaning and subcategory of a verb. Second, a modifier (as the names "instrumental," "locative" and "benefactive" indicate) contributes to meaning in the same way in any sentence in which it is used, whereas the semantic role played by an argument depends entirely on the lexical meaning of the verb--a subject or object, for example, may denote a thing that comes to exist with one verb, a thing that ceases to exist with another, an experiencer of an emotion with a third, and so on.

Ultimately, however, I have argued (Dowty 1982, 116-119) that the distinction between arguments and modifiers should be recognized as somewhat fluid from the point of view of language change and language acquisition, if we are to explain the large number of convergent case markings in various languages between the two kinds of NPs, e.g. between datives and benefactives, or between agents of passives and instrumentals. What for the child (or at an earlier stage of the language) are NP modifiers of an n -place verb may later be reanalyzed as NP arguments of a $n+1$ place verb.

Since we are dealing with a monostratal syntactic theory, so-called "relation changing rules" are not analyzed as rules which change the grammatical status of a NP argument but are rather treated as rules which alter the grammatical and semantic properties of a verb (or verb phrase) itself before its NP arguments are combined with it. Specifically, the denotation of a verb or verb phrase is an n -place relation, and the semantic effect of relation-changing rules is to perform simple algebraic operations on verb meanings, operations such as reducing an n -place relation to a $n-1$ place relation, rearranging the argument places of a relation, or expanding an n -place relation to an $n+1$ place relation. Agentless passive and indefinite object "deletion" are examples of relation-changing rules which reduce a relation by eliminating the subject or object argument, respectively. Agentive Passive, Dative Shift, and the Raising rules are examples of operations which rearrange the argument hierarchy of a VP. Finally, causative rules and rules for the "applied" forms in Bantu languages are examples of relation-expanding rules (rules which increase the number of argument positions of a verb phrase). Formalizations of all of these rules can be found in (Dowty 1982), so for now, let me illustrate the application of relation-changing rules, as well as the derivation of sentences with unchanged grammatical relations, by only a few examples.

The agentless passive rule in English can be given the (somewhat simplified) formulation in (7): it converts a transitive verb to a passive intransitive verb syntactically, and semantically it existentially quantifies the verb's original subject and reinterprets its new subject like the original direct object:

- (7) (Agentless Passive). If $\alpha \in TV$, then $F_7(\alpha) \in IV$, where

$$F_7(\alpha) = \text{be } \alpha + EN.$$

Translation: $\lambda p [\alpha' (p) (\exists x^*)]$

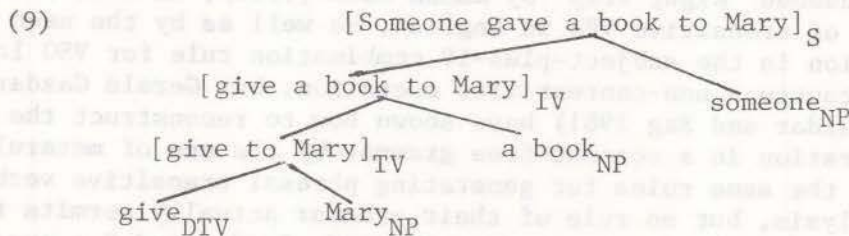
(here, " $(\exists x^*)$ " abbreviates " $(\hat{P} \exists x P\{x\})$ "

Dative Shift can be formulated as in (8): syntactically, it shifts a verb between the two English subcategories of three-place verbs I mentioned earlier, that is, from DTV (the category of dative transitive verbs) to TTV (the category of ditransitive verbs). Semantically, the rule alters the meaning of the original verb by inverting the direct and indirect arguments:

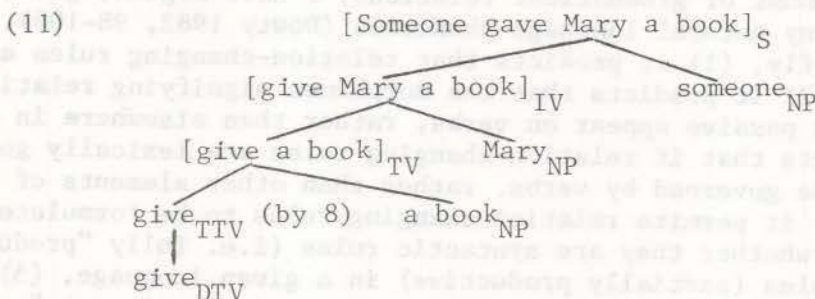
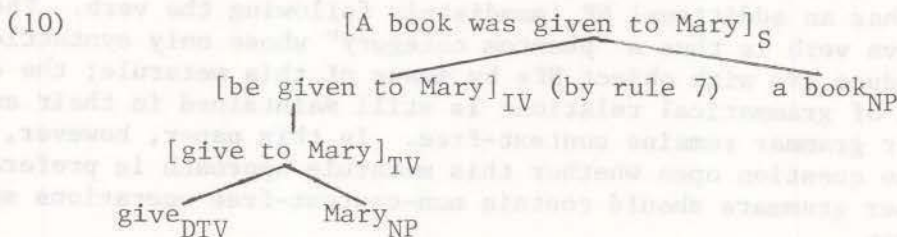
(8) (Dative Shift). If $\alpha \in \text{DTV}$, then $F_8(\alpha) \in \text{TTV}$, where $F_8(\alpha) = \alpha$.

Translation: $\lambda p_1 \lambda p_2 \lambda p_3 [\alpha' (p_2) (p_1) (p_3)]$

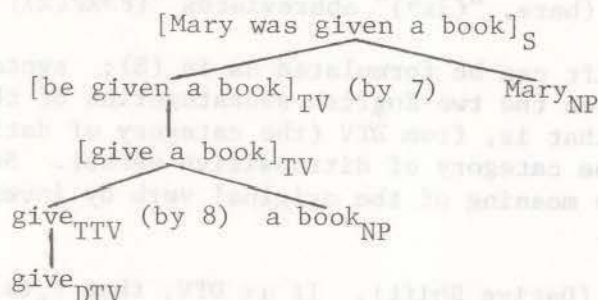
The analysis tree in (9) illustrates a sentence with a three-place verb in which neither of these two rules is used; (10) is an example with Agent-less Passive alone; (11) is an example with Dative Shift, and (12) illustrates the use of both rules. By the translation rules given in (7) and (8), all three sentences will receive logically equivalent interpretations, specifically, that of the translation (9').



(9') $\exists x \exists y [\text{book}'(y) \wedge \text{give}'(x, y, m)]$



(12)



(The Raising rules, not given here, will also interact with passive to produce and correctly interpret those examples which are produced in transformational accounts by successive 'movement' of a NP through various clauses, though of course no movement is involved in this analysis.)

One thing that should be noted in these analysis trees is that a transitive verb phrase is uniformly combined with the direct object NP not by simply concatenating the two phrases but rather by inserting the object NP after the first word in the phrasal transitive verb. This operation, dubbed "Right Wrap" by Emmon Bach (1980), is motivated by other cases of transitive VPs in English, as well as by the need for this operation in the subject-plus-IV combination rule for VSO languages. This is of course a non-context-free operation, but Gerald Gazdar and Ivan Sag (Gazdar and Sag 1981) have shown how to reconstruct the effect of this operation in a context-free grammar by the use of metarules. They employ the same rules for generating phrasal transitive verbs as in this analysis, but no rule of their grammar actually permits the node TV to be dominated by another node. Instead, Gazdar and Sag propose a metarule which specifies that for any rule producing a transitive VP, there is to be another rule producing an IV that is exactly like it except that it has an additional NP immediately following the verb. The category transitive verb is thus a "phantom category" whose only syntactic function is to induce IVs with object NPs by means of this metarule; the categorial analysis of grammatical relations is still maintained in their analysis, but their grammar remains context-free. In this paper, however, I will leave the question open whether this metarule approach is preferable or whether grammars should contain non-context-free operations such as Right Wrap.

This account of grammatical relations, I have argued, gives a superior account of many natural language phenomena (Dowty 1982, 98-108). These include, briefly, (1) it predicts that relation-changing rules are structure-preserving, (2) it predicts that the morphemes signifying relation-changing rules such as passive appear on verbs, rather than elsewhere in the sentence, (3) it predicts that if relation-changing rules are lexically governed, they should be governed by verbs, rather than other elements of the sentence, (4) it permits relation-changing rules to be formulated in the same way whether they are syntactic rules (i.e. fully "productive") or lexical rules (partially productive) in a given language, (5) it permits an elegant explanation of certain "discontinuous constituents" such as the constituent "verb phrase" in VSO languages like Breton, (6) it gives rise to a simple explanation of the distinction between subject controlled complements, as with the verb promise, and object-controlled complements as with the verb persuade, (7) it predicts the behavior of derived causatives which led Newmeyer (1976) and Aissen (1974) to propose that causative

is a precyclic transformation, (8) it allows a simple yet adequate account of the "wanna" contraction facts, (9) and perhaps most important of all, I suggest that it provides a natural and fairly adequate account of "grammatical relations" which neither takes grammatical relations as completely primitive concepts, nor makes reference to multiple levels of syntactic description, nor requires that grammatical relations be defined in any way in terms of so-called thematic relations such as agent, patient, goal, theme, etc., nor in terms of any intermediate level of description between syntax and semantic interpretation (i.e. denotations and truth conditions). This last point is particularly important to keep in mind in comparing the categorial analysis of grammatical relations with other, more complex accounts involving multiple levels. For if these more complicated accounts purport to capture certain linguistic generalizations which the categorial analysis does not, then it behooves us to examine these putative generalizations to see whether they are really so significant or so cross-linguistically valid to outweigh the relative theoretical complexity which these other accounts require.²

2. Rules Generalized over Grammatical Relations

2.1. Passives

Having now sketched the outlines of the categorial account of grammatical relations and relation-changing rules, I turn to some unresolved problems for this analysis.

The first kind of problem is the case of languages where it has been suggested that two NPs behave as direct object (DO) in the same clause simultaneously. For example, Seiter's (1979) analysis of Nieuwean proposes that this language has a rule which advances an instrumental NP to DO. This advanced instrumental then participates in several syntactic processes that are otherwise restricted to subjects and objects, but the original DO NP still participates in these same processes after the instrumental has been advanced.

Similarly in a number of Bantu languages, there is a construction in which a NP with locative, benefactive or instrumental meaning appears in the syntactic position of the DO and behaves, with respect to other syntactic rules, as if it were a DO. (Yet the original DO still passivizes.)

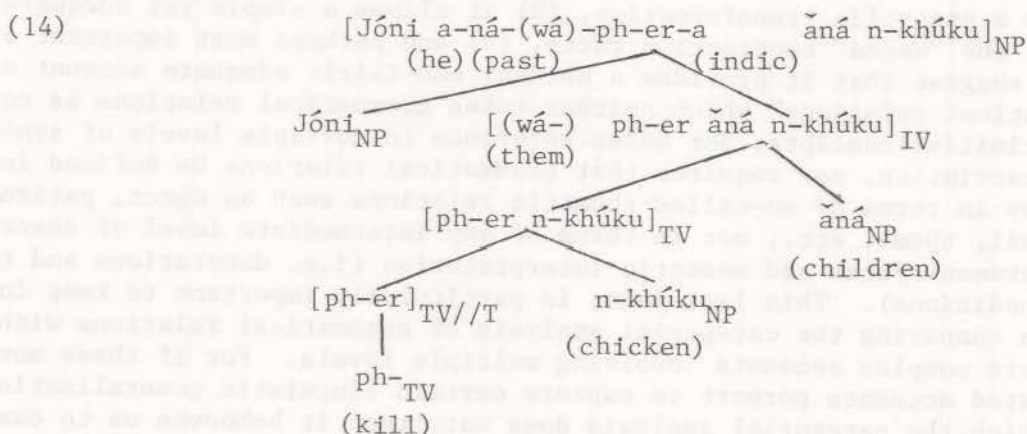
In the categorial analysis, this will be a case of a relation-expanding rule in which the added NP appears as the DO of the derived verb and the original DO becomes the secondary object of the new verb. The syntactic rule for the benefactive construction of this group can be described by the rule in (13):

(13) (Bantu applied benefactive construction)

If $\alpha \in TV$, then $F_{13}(\alpha) \in TTV$. (For Chichewa, $F_{13}(\alpha) = \alpha + (e/i)r$).

Translation: $\lambda p_1 \lambda p_2 \lambda p_3 [\text{ben}'(p_2)(\alpha'(p_1))(p_3)]$

The corresponding translation rule specifies that the meaning of the direct object of the new verb will be used semantically as a benefactive VP modifier would be used in English: ben' is here a constant denoting the benefactive relation. The secondary object of the new verb is interpreted as the DO of the original verb. The illustrative analysis tree (14) is based on Chichewa data from Trithart (1979):



'John killed the chicken for the children.'

Translation: (ben'(the-children'))(kill'(the chicken'))(John')

This construction has been viewed as a problem for the theory of Relational Grammar for two reasons. First, as Trithart observes, there is no corresponding sentence, in many of these languages, in which the benefactive, instrumental or locative surfaces in unadvanced form, so there is no purely syntactic motivation for this advancement rule. The second problem, the one which is of interest to us, is that in "applied" sentences, sentences like (14), it is possible to passivize not only the putatively "advanced" instrumental, benefactive or locative but also the original NP as well. Thus corresponding to the active sentence (15), there are two passive forms (16a) and (16b):

- (15) Cátherine a- ná- (wá-) phik- ir - a ǎ-ná n-síma
Catherine she past them cook apl. indic children nsima

'Catherine cooked nsima for the children.'

- (16) a. á-ná a- ná (yí) phik-ir - idw -a n-síma
children they past (it) cook apl. pass indic

'The children were cooked nsima.'

- b. n-síma yi-ná (yí) phik - ir - idw - a ǎ-ná
nsima it past (it) cook apl. pass indic children

'Nsima was cooked (for) the children.'

Of course, we do not have to go so far from home to see this sort of problem, for it can be found in some dialects of English as well. If example (18) indicates a case where an indirect object has been advanced to DO, *vís-a-vís* (17),

- (17) John gave a book to Mary.

- (18) John gave Mary a book.

then if Passive indeed applies only to DO (which is to say, in the categorial analysis, that it applies only to transitive verb phrases), then the only passive corresponding to (18) should be (19); in some dialects, however, the passive (20) is acceptable as well:

- (19) Mary was given a book (by John).
 (20) A book was given Mary (by John).

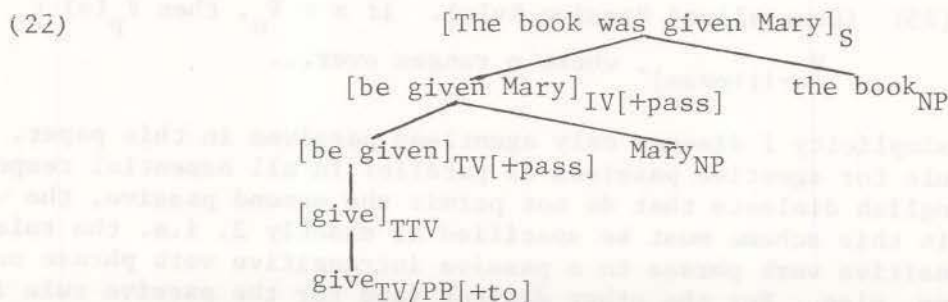
This example, and the Chichewa case (16), present a problem both for the categorial analysis and for early versions of Relational Grammar. In Relational Grammar, this situation conflicts either with the Chômeage condition or the Stratal Uniqueness Condition. If we try to maintain that the second NP after the verb in (18) is a demoted DO, then the Chômeage Condition is violated in examples like (10), since a NP that is en chômeage is not supposed to be advanceable by Passive or other advancement rules. If on the other hand we maintain that both NPs following the verb are DOs at the time that Passive applies, then the Stratal Uniqueness Law is violated, which states that only one NP can occupy a single grammatical relation at a given stage of the derivation.

Because of cases like this where more than one NP seems to behave as a DO (and especially because of cases like Niuean where several syntactic processes seem to identify two NPs as DOs), some relational grammarians (Seiter 1979, Keenan and Gary 1977) have indeed proposed that Stratal Uniqueness be abandoned. In the theory of Relational Grammar it is possible in principle to dispense with this law and still leave the theory otherwise intact, for that theory is presently formulated as a large body of axioms (including Stratal Uniqueness) which are theoretically independent of one another, hence any one can be deleted without any inconsistency. In the categorial analysis, on the other hand, this move is not possible, for the equivalent of Stratal Uniqueness is not an axiom but a principle which follows automatically from the Montague-Schoenfinkel method of defining grammatical relations in the first place.³

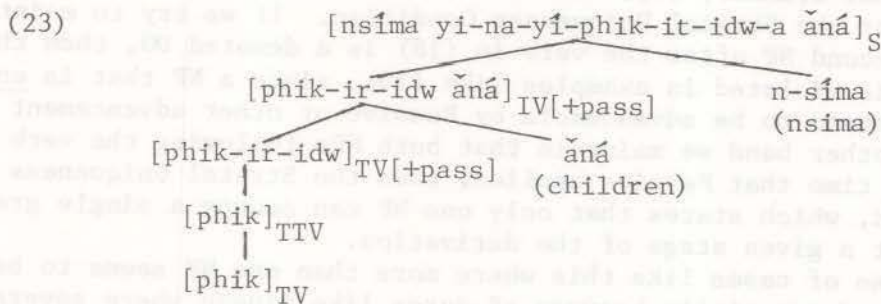
Rather, the categorial analysis seems to force us to the claim that these two NPs bear distinct grammatical relations; therefore since both of them can passivize there is no alternative in the categorial analysis but to suppose that there are two distinct passive operations involved here: one the regular passive (which passivizes a transitive verb phrase and thus leads to the sentence (19)) and another, which I have called in earlier papers (Dowty 1978, 1981) the second passive rule, is responsible for the passive form (20). This second passive rule can be formulated as (21) for English: it passivizes a ditransitive verb and yields a passive transitive verb as a result; this passive transitive verb then combines with a NP argument as illustrated in (22) to form an intransitive passive verb phrase.

- (21) (2nd passive rule). If $\alpha \in \text{TTV}$, then $F_p(\alpha) \in \text{TV}[\text{+pass}]$,
 where $F_p(\alpha) = \text{be } \alpha \text{ +en}$.

Translation: $\lambda p_1 \lambda p_2 [\alpha' (p_2) (p_1) (\exists x^*)]$



The second passive rule for Chichewa and other Bantu languages would be exactly parallel to this English rule; a sample analysis tree is given in (23):



'Nsima was cooked (for) the children.'

This method of "doubling" the passive rule will be at least observationally adequate for any language in which secondary objects as well as direct objects passivize, and other syntactic rules that apply to both direct and secondary objects in various languages (e.g. quantifier floating in Niuean) can likewise be "doubled". However, this method is open to the charge of missing a significant generalization, namely, that these rules in these languages all seem to be treating direct objects and secondary objects exactly alike and therefore should preferably be described by a single passive rule (or a single quantifier floating rule, etc.) that applies to direct and secondary object position indifferently.

Although I have made it clear why the two kinds of passive rule cannot literally be the same rule under the categorial analysis, we could however capture the generalization in question here by making the passive a rule schema which applies to more than one category of verb phrase. This is exactly what I now propose to do.

First, let us rename the categories intransitive verb phrase, transitive verb phrase, and ditransitive verb phrase by designating them all with the symbol V plus a numerical subscript indicating the number of arguments the verb takes, as indicated in (24):

- (24) V_1 = intransitive verb phrase (categorially, IV)
 V_2 = transitive verb phrases (categorially, TV, or IV/T)
 V_3 = ditransitive verb phrases (categorially, TTV, or TV/T)

The generalized passive rule is now written as (25):

- (25) (Generalized Passive Rule). If $\alpha \in V_n$, then $F_p(\alpha) \in V_{n-1}[+pass]$, where n ranges over...

(For simplicity I discuss only agentless passives in this paper, since the rule for agentive passives is parallel in all essential respects.) For English dialects that do not permit the second passive, the value of n in this schema must be specified as exactly 2, i.e. the rule converts a transitive verb phrase to a passive intransitive verb phrase and does nothing else. For the other dialect (and for the passive rule in Chichewa),

the value of \underline{n} must be allowed to be equal to or greater than 2, hence the rule may also convert a ditransitive VP into a passive transitive VP, thus giving rise to derivations like (22) as well as "regular" passives like Mary was given a book.

Now consider how the corresponding semantic rule may be schematized. The translation rule we want to arrive at for the case where the input phrase α is a transitive verb is (26a), and the rule we want for the case where the input phrase is ditransitive is (26b): what do these two translations have in common?

- (26) a. For $n = 2$: $\lambda p_1 [\alpha' (p_1) (\exists x^*)]$
 b. For $n = 3$: $\lambda p_2 \lambda p_1 [\alpha' (p_1) (p_2) (\exists x^*)]$
 c. For $n = 4$: $\lambda p_2 \lambda p_3 \lambda p_1 [\alpha' (p_1) (p_2) (p_3) (\exists x^*)]$
 d. For $n = 1$: $[\alpha' (\exists x^*)]$

It seems that both these cases can be characterized as "advancing" by semantic means the lowest argument of a verb (its direct or secondary object) to its highest argument (i.e. its subject) and putting an "existential quantifier" in place of the original highest argument. Now I presently know of no cases where such a generalized passive rule needs to apply to a four-place verb, but as long as we are schematizing the rule, let us go ahead and hypothesize, for the sake of illustration and for concreteness, what such a generalized rule might do in this case. Suppose in this case that the rule needs to advance the lowest argument to the highest one, existentially quantify the original highest argument position, and leave the intermediate arguments in the same hierarchy. Then the translation rule we would want for this case is the one in (26c). Now in order to write the schematized translation let me introduce some abbreviations:

- (27) $\lambda(1, \dots, n)$ abbreviates $\lambda p_1 \lambda p_2 \dots \lambda p_n$
 $\alpha(1, \dots, n)$ abbreviates $\alpha(p_1) (p_2) \dots (p_n)$

A lambda in front of a parenthesized ellipsis 1 through \underline{n} abbreviates a sequence of lambda operators each attached to the respective variables p_1, p_2 , etc. through p_n . A predicate α in front of an ellipsis 1 through \underline{n} indicates the predicate α applied first to the argument p_1 , then to the argument p_2 , and so on, until finally applied to p_n . We now write the schematized translation rule as (28).

- (28) (Translation rule for Generalized Passive):
 $\lambda(2, \dots, n-1, 1) [\alpha' (1, \dots, n-1) (\exists x^*)]$

The numbers 1 and 2 which appear in this rule must of course be understood to be limited by the value of \underline{n} : that is, if $\underline{n} = 2$, then p_2 does not actually appear in this instance in the translation rule (i.e. in (26a)) since the last element in the ellipsis is $\underline{n}-1$, which is 1.

Similarly, if we considered the instance of the schema where $\underline{n} = 1$, then

$\underline{n}-1$ is zero and both ellipses represent empty sequences, hence the interpretation of the translation schema for $\underline{n} = 1$ is (26d).

Now the particular notation I have chosen to represent this schematized translation rule may be a bit clumsy and could in any case be written in other ways. All that is involved here, as far as the model-theoretic interpretation which these translations represent is concerned, is simply generalized operations over \underline{n} -place relations, operations such as reducing an \underline{n} -place relation to an $\underline{n}-1$ place relation or inverting an \underline{n} -place relation. W. V. Quine, for example, discusses just these operations in his article "Variables explained away", Quine (1966), but he symbolizes these generalized operations not by lambda expressions but by defining single operator symbols which represent each generalized operation. The translation rule here could be written much more simply in Quine's notation by prefixing to α first the operator which inverts a relation and then prefixing in turn the operator which reduces a relation by one place (by existentially quantifying its last argument position). However, I think the notation I have used here may be a bit more perspicuous for our purposes.

This use of a passive rule schema gives us a way of saying, in effect, that the language simply does not distinguish between transitive and ditransitive verb phrases when it comes to applying the passive rule. If this is a significant fact about some languages, then presumably this means that transitive and ditransitive verb phrases (or equivalently, the notions direct object and secondary object) form a natural syntactic class. If so, then we might want to make this fact explicit by proposing that a syntactic feature defines this class, and use this feature to restrict the passive schema, rather than restricting the value of the numerical subscript in the rule schema. We might thus distinguish the various transitivity classes of verb phrases by a system of two features such as (29):

(29) Transitivity classes defined by syntactic features

[+nuclear]	$\{V_1, V_2\}$	(the set of transitive and intransitive VPs)
[+transitive]	$\{V_2, V_3\}$	(the set of transitive and ditransitive VPs)

Here the feature [+nuclear] (a term borrowed from Relational Grammar) designates the putatively natural class of 1-place and 2-place predicates, while the feature [+transitive] designates the class of 2-place and 3-place predicates. Combinations of values for the two features can also single out intransitives, transitives, and ditransitives separately. With this system, we could say that in Chichewa and in some dialects of English the passive rule applies to the class [+transitive], while in other dialects of English (those that do not allow sentences such as A book was given Mary), the passive rule applies to the class [+nuclear, +transitive]. Whether such "natural classes" are actually well-motivated, however, is a question I would like to leave open for now.

The use of rule schema to abbreviate a sequence of individual rules is reminiscent of Gerald Gazdar's (1982) use of schema to represent rules for conjunctions of \underline{n} constituents. However, I do not believe the idea of schematizing rules to apply to predicates of varying numbers of arguments is very familiar, so let me motivate this idea by suggesting some further

applications for it. Since we have employed this schema to generalize passive over transitives and ditransitives, we might also ask whether languages might generalize passive "upward", that is, so that it applies to intransitives as well as transitives. In fact, I suggest this is just what does happen in the case of impersonal passives. That is, if n is set equal to 1, then the generalized passive rule (25) will derive a zero-place predicate from an intransitive verb phrase and will give the appropriate semantics for an impersonal passive, namely that of the case (26d) above. (I should point out that von Stechow (1979) has also proposed a treatment of passives and impersonal passives in German that is much like what I am proposing here.) Of course, further syntactic details of impersonal passives in various languages will still have to be specified; for example, some languages such as German allow a dummy "it" in impersonal passives (cf. (30)),

(30) Es wird heute getanzt.

and some other means besides the generalized passive rule must be found for introducing this dummy. However, it has been observed (Curme, 1924; Nerbonne, this volume) that this "it" in German is definitely un-subject-like and fails to behave as subjects in German ordinarily do in a number of ways (even though other dummies in the language, such as "weather" it and the it of extraposition, do behave as subjects in all these same respects). Nerbonne concludes that the best analysis of (30) is that it is a subjectless sentence. Also, languages such as Turkish (Perlmutter 1978) have impersonal passives but have no dummy subjects at all. If there are other languages in which impersonal passives exhibit a dummy that is truly a subject in all respects, then a modification of the generalized passive rule I have given will be necessary here.

It may also be noted that this treatment of impersonal passives will permit impersonal passives to be formed on transitive and other verb phrases as well. For when a transitive verb has combined with its object, it then constitutes an intransitive verb phrase, and this phrase can undergo impersonal passivization just like a VP consisting of a lexical intransitive verb alone. On the other hand, impersonal passive might be a lexical rule in some languages (just as any relation-changing rule might be, under the categorial analysis, cf. Dowty 1982), but if it is a lexical rule it could not be fed by syntactically complex expressions such as verb phrases consisting of a transitive verb plus object. Thus it is a prediction of this kind of analysis that if impersonal passivization has lexical exceptions in a language, then transitive verbs should not have impersonal passives in that language, and conversely, if a language does permit impersonal passives with transitive verbs, then it is a syntactic rule and should not have lexical exceptions. (This is a prediction parallel to one made about regular passives of transitive verbs in the categorial approach: the regular passive rule might be either a lexical or a syntactic rule in general, but if it is a lexical rule, it should be fed only by lexical transitive verbs, not by syntactically complex transitive verb phrases. Since English, for example, does exhibit passives of complex transitive verb phrases, it follows in this theory that passive in English is a syntactic rule, a position that has been defended at length by Emmon Bach (1980).)⁴

2.2. Purpose Clauses

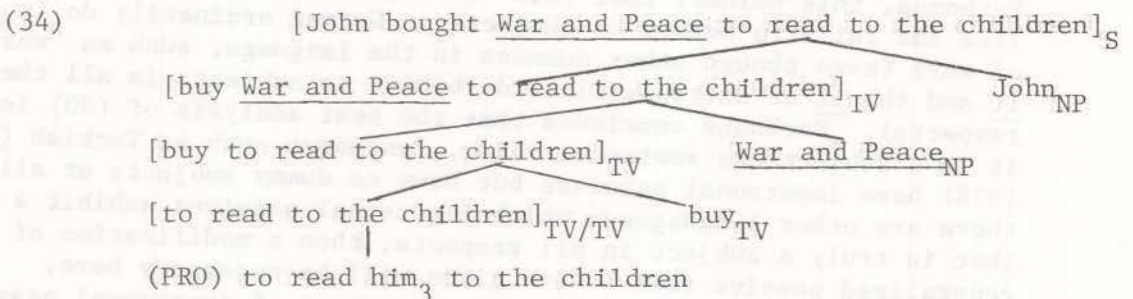
A second case where we might employ rule schema generalizing over grammatical relations is the case of the purpose classes discussed by Emmon Bach (1982). Bach has claimed that infinitival purpose clauses, such as that exemplified in (31), are restricted to transitive verb phrases, or else are the arguments of one of a handful of verbs lexically subcategorized for them such as have and be. Thus (32) is unacceptable, according to Bach, because the verb come in is intransitive.

(31) They brought in the Dean for us to talk to.

(32) *The Dean came in for us to talk to.

Bach's analysis of a sentence such as (33) is that the purpose clause is a modifier of a transitive verb phrase, so the sentence (33) has a syntactic analysis (34):

(33) John bought War and Peace to read to the children.



This transitive verb modifier is formed by syntactically and semantically binding the DO variable him₃ within the clause: this will ultimately be bound by the DO of the matrix clause. The subject of the purpose clause, here PRO, is however an instance of free control according to Bach; its interpretation is determined by various semantic and pragmatic conditions, but its binding is not a matter of compositional semantics at all. Purpose clauses are subject to further semantic and pragmatic conditions, but they are not of interest to us here.

Unfortunately for Bach's claim, there are counterexamples to it in his own paper. These are cases such as (35).

(35) John gave Mary War and Peace to read to the children.

Assuming the analysis of ditransitive give which I have argued for (and which Bach likewise assumes), it is not the NP War and Peace which is the grammatical DO in (35) but rather the NP Mary. Nevertheless, it is War and Peace which clearly binds the gap in the purpose clause in this sentence. Notice that it would not help Bach's position to suppose that there is a second syntactic analysis for give in this case according to which the NP War and Peace is the true grammatical DO. This is because (36) shows that Mary can be passivized in this example, and this clearly indicates that Mary is the true DO.

(36) Mary was given War and Peace to read to the children.

Just to complete the picture, let us note that there are also cases with the dative form of the verb give and a purpose clause (37), and here War and Peace IS the grammatical DO.

- (37) John gave War and Peace to Mary to read to the children.
 (38) War and Peace was given to Mary to read to the children.

Although both the DO and the secondary object of a verb like give can bind the gap in the purpose clause, it is not the case that just any NP within the matrix VP can bind this gap. Note that in (39) the gap can only be bound by the object NP the book, not by the (pragmatically more plausible) prepositional object the table:

- (39) John put the book on the table to study on.

We could of course salvage Bach's analysis by supposing that such purpose clauses are systematically ambiguous--that they may modify either transitive verb phrases such as give to Mary in (37), or ditransitive verbs such as give in (35); in either case, the object NP next added to the VP would be the one binding the gap in the purpose clause. (For pragmatic reasons discussed by Bach, only one reading would be apparent in each sentence.) Such a suggestion would be open to the charge of failing to capture a generalization. But here again, we could counter this objection by formulating the purpose clause rule as a rule schema which applies to both transitive and ditransitive phrases, just as we did with passives. This generalized rule might be written as in (40):

- (40) (Generalized Purpose Clause Rule). If $\alpha \in V_n$ and $\beta \in IV$, then

$F_{40,m}(\alpha, \beta) \in V_n$, where $F_{40,m}(\alpha, \beta) = \alpha$ to β' , β' being β

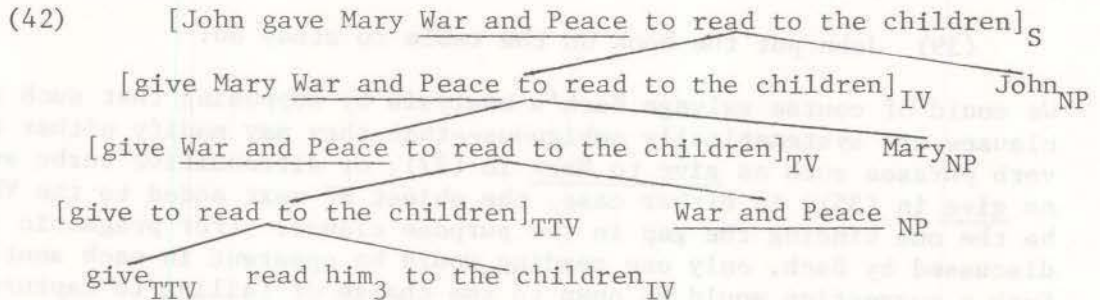
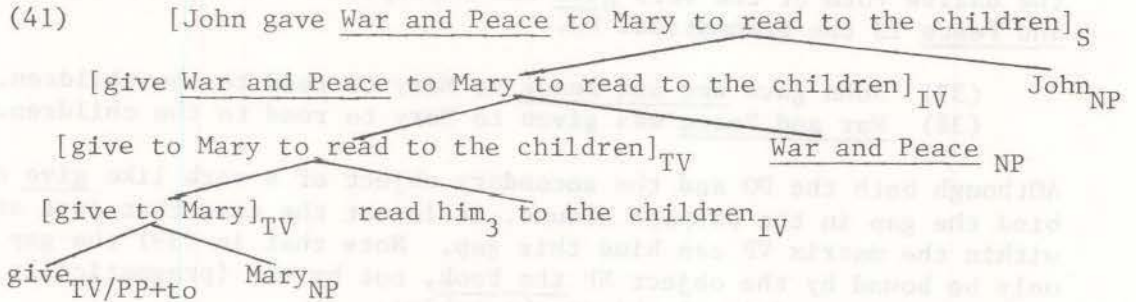
with him_m deleted. Here, $n \geq 1$ (or, equivalently, the rule

applies to $V_{[+transitive]}$.)

Translation: $\lambda(1, \dots, n)[\alpha'(1, \dots, n) \wedge \text{intend-}$

that'($\mathcal{P}_n, \wedge[\mathcal{P}_1\{\hat{x}_m[\beta'(z)]\}]]$)

The second half of this translation rule is for illustrative purposes and should not be taken too seriously; it may only roughly approximate the meaning of purpose clauses. (The variable z on the right is to be a free variable, corresponding to the pragmatically controlled "PRO" in Bach's tree.) For illustration, (41) and (42) are analysis trees in which the two instances of this schema have applied, the purpose clause modifying a transitive VP in the first case, a ditransitive VP in the second:



The translation rule schema will assign the proper interpretation to each of these trees: that is, the NP War and Peace will bind the object gap in the purpose clause in each case.

2.3. Reflexive Control

Next, I will point out a case where generalized rules can be used to efficiently describe a process that applies to both direct objects and subjects in English. In their paper "Passives and Reflexives in Phrase Structure Grammar" (Gazdar and Sag 1981) Gerald Gazdar and Ivan Sag show how the syntactic distribution and semantic binding of reflexive pronouns in English can be treated in a Generalized Phrase Structure Grammar. There are two syntactic positions in English which control reflexive pronouns: subject and object. Gazdar and Sag's analysis involves two rules whose translation specifies this semantic binding. By making the slight notational changes necessary to recast their analysis in the grammatical format I have adopted here, we might restate their analysis as the two rules (43) and (44):

- (43) If $\alpha \in IV_{[+SELF]}$, then $F_i(\alpha) \in IV_{[-SELF]}$ (F_i is the identity mapping).

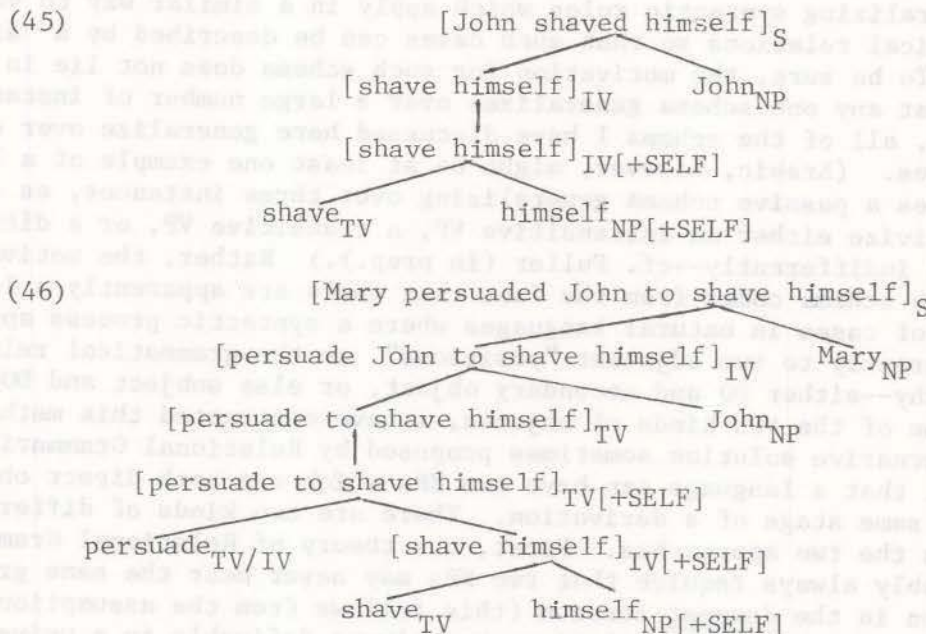
Translation: $\lambda p_1 p_2 \{\hat{r}[\alpha'(r^*)]\}$

- (44) If $\alpha \in TV_{[+SELF]}$, then $F_i(\alpha) \in TV_{[-SELF]}$

Translation: $\lambda p_1 \lambda p_2 p_1 \{\hat{r}[\alpha'(r^*)(p_2)]\}$

I assume that reflexive pronouns such as himself, herself, yourself, etc. carry the syntactic feature [+SELF] and that there are general syntactic feature conventions, essentially the same as Gazdar and Sag's, for passing

this feature and other syntactic features recursively up onto the syntactic category label of any constituent containing a reflexive pronoun. (Since Gazdar and Sag are using phrase structure rules rather than the inductive syntactic rules I am using, their conventions are actually viewed as passing such features "down" the tree rather than "up" an analysis tree as I view them here; but this is not an important difference.) In the present version, the two rules (43) and (44) then "eliminate" this feature [+SELF] and at the same time specify that the argument of the IV or TV in question will semantically "bind" the reflexive pronoun within the verb phrase. These rules will then give rise to derivations such as (45) and (46) and will assign these the appropriate interpretations:



Actually, Gazdar and Sag's analysis does not really involve the analogue of (45) and (46) as true syntactic rules but rather as metarules--that is, rules which take any existing syntactic rule that forms a non-reflexive IV or TV from non-reflexive parts and give as output a new syntactic rule that is identical except that it forms a non-reflexive IV or TV from constituents that do involve the feature [+SELF]. We could in fact adopt this metarule approach here, but I do not in the interest of expository simplicity: if we did use the metarule approach note that the analysis trees (45) and (46) would in fact be one node shorter, as they would lack the TV and IV nodes, respectively, that bear the feature [+SELF].

Nevertheless, the analysis involving rules (43) and (44) is suspiciously redundant (as is Gazdar and Sag's original analysis) in that it involves two rules and two translation rules that look exactly alike except that one involves the category IV where the other involves the category TV.

We can, once again, avoid this redundancy by replacing both rules by the single rule schema (47) that generalizes over these two categories:

(47) (Reflexive control rule generalized)

If $\alpha \in V_{n[+SELF]}$ then $F_i(\alpha) \in V_{n[-SELF]}$; here $n \leq 2$ (or equivalently, the rule takes $V_{[+Nuclear]}$ as input)

Translation: $\lambda(1, \dots, n) \mathcal{P}_1\{\hat{F}[\alpha'(r^*)(2, \dots, n)]\}$

To conclude this section, let me say that I have proposed a method of generalizing syntactic rules which apply in a similar way to various grammatical relations so that such cases can be described by a single rule. To be sure, the motivation for such schema does not lie in the fact that any one schema generalizes over a large number of instances: in fact, all of the schema I have discussed here generalize over exactly two cases. (Arabic, however, might be at least one example of a language that uses a passive schema generalizing over three instances, as it appears to passivize either an intransitive VP, a transitive VP, or a ditransitive VP indifferently--cf. Fuller (in prep.).) Rather, the motivation for such schema comes from the fact that there are apparently a large number of cases in natural languages where a syntactic process applies indifferently to two adjacent "positions" on the grammatical relation hierarchy--either DO and secondary object, or else subject and DO. In the case of the two kinds of objects, I have contrasted this method with an alternative solution sometimes proposed by Relational Grammarians--namely, that a language can have two NPs which are both direct objects at the same stage of a derivation. There are two kinds of differences between the two approaches. First, the theory of Relational Grammar will presumably always require that two NPs may never bear the same grammatical relation in the deepest stratum (this follows from the assumption that the deepest grammatical relations are always definable in a universal way in semantic terms). Rather, the case of two NPs bearing the same grammatical relation could only arise if one of the two had been promoted or advanced from some other relation. As I already mentioned in the Bantu case, however, there is sometimes no real independent syntactic motivation for deriving, say, an "advanced" benefactive NP from an underlying non-direct object position, so this is an ad hoc assumption.⁵ Also in English this kind of assumption would lead to syntactically unmotivated underlying strata. As far as I am aware, the dialects of English that allow a secondary passive with verbs like give, as exemplified in (48),

(48) A book was given John.

also allow secondary as well as primary passives of verbs like spare, deny, and forgive, as in (49)-(51):

- (49) a. The ordeal was spared us.
- b. We were spared the ordeal.

- (50) a. Our sins were forgiven us.
- b. We were forgiven our sins.

- (51) a. A fair trial was denied him.
- b. He was denied a fair trial.

However, such verbs do not occur in sentences where the personal object occurs after the preposition to, i.e. sentences such as *Someone spared the ordeal to us, *Someone forgave our sins to us, etc. are ungrammatical. It would be ad hoc to assume that such sentences have underlying indirect objects in order to explain why they can come to have two direct objects and therefore two passives.

A second difference between these two ways of explaining how two NPs can behave as direct objects is that in my account, the generalization of syntactic operations over grammatical relations is stated rule by rule: thus it allows us to say that some rules may fail to distinguish between two adjacent grammatical relations while other rules in the same language apply to only one of the cases. And in fact we want to be able to say this in the cases I have discussed here. Trithart observes that Chichewa treats the applied object (or DO) and secondary object alike with respect to passive, but only the applied object, not the secondary object, can be reflexivized. And in the case of English, many American English dialects treat DO and secondary object alike as far as purpose clauses go, but nevertheless allow only DOs to passivize. A language like Niuean is simply the limiting case where all syntactic rules of the language fail to distinguish between a DO and a secondary object.

The examples I have discussed in this section do not exhaust the cases where generalized rules of this sort can be put to good use. One obvious application is the "accessibility hierarchy" for relativization. While I admitted in Dowty (1982) that the analysis of that paper offered no account of the role the Relational Hierarchy seems to play in limiting the accessibility of NPs to relativization (Keenan and Comrie 1977), schema generalized over grammatical relations can be used to replace the familiar "variable binding" analysis of relativization in traditional Montague Grammar in such a way as to permit a simple statement of Keenan and Comrie's generalizations. (If relativization applies to V_{n+1} in a given language, it must apply to V_n as well.) This analysis has been developed by Pauline Jacobson in her comments on David Perlmutter's paper at the 1981 Annual Meeting of the Linguistic Society of America and may appear in future work of Jacobson's.

3. Equi and Raising Verbs and the Treatment of Dummies.

The last topic I want to address is the treatment of the distinction between Equi verbs and Raising verbs in the categorial analysis.

- (52) a. Mary tried to win.
b. Mary seemed to win.
- (53) a. Mary persuaded John to be present.
b. Mary believed John to be present.

While classical transformational grammar assumed that pairs like (52a)-(52b) and (53a)-(53b) have differing deep syntactic structures, more recent "surfacy" syntactic theories (cf. Brame 1978, Bresnan 1978, Gazdar 1982) of course do not. Nevertheless, many of these recent analyses persist in assuming that there is still somehow or other a distinction in the compositional semantic structure of these pairs. That is, it is suggested that semantic rules must sooner or later assign (52a) a semantic structure like (56), in which the meaning of "to win" is supplied with its own subject "John", a duplicate of the matrix subject,

(56) try'(win'(John'))(John')

and (52b) is assigned a semantic structure like (57), in which the meaning of seem is a function applying to the whole proposition "John wins":

(55) seem'(win'(John))

Similarly, it is assumed that the semantic structures of (53a) and (53b) must differ along the lines of (56) and (56):

(56) persuade'(be-present'(John'))(John')(Mary')

(57) believe'(be-present'(John'))(Mary')

This kind of assumption appears most recently in a paper by Ewan Klein and Ivan Sag called "Semantic Type and Control", read at the 1981 Annual Meeting of the Linguistic Society of America. I don't want to discuss the very interesting and ingenious explanation of control properties of verbs that they present, but rather merely note that their analysis rests in part on the assumption that the basic lexical meanings of, say, try and seem differ in semantic type in just the way (56) and (57) indicate. (What they do in the paper is propose a set of rule-independent semantic principles that in each case will resolve the discrepancy between the lexical type of a verb and the syntactic structure in which that verb appears in such a way as to predict all control properties correctly.)

However, this traditional and time-honored assumption about a difference in the semantic structures of Equi and Raising verbs is quite gratuitous; rather it suffices for the grammar to put together the meanings of Equi and Raising sentences in exactly the same compositional way. Specifically, the meaning of the matrix verb in both (52a) and (52b) can quite simply be treated as a function applying to a VP meaning to give another VP meaning (much as Montague did in PTQ), and this is then applied to the subject meaning to give that of the whole sentence. To say the same thing, these verbs will denote relations between individuals and properties. Thus the meanings of both sentences can be produced compositionally as in (58)-(59)

(58) try'(win')(John')

(59) seem'(win')(John')

The same goes, mutatis mutandis, for persuade and believe, as in (60) and (61)

(60) persuade>('be-present')(John')(Mary')

(61) believe'(be-present')(John')(Mary')

What semantic differences there are between each pair of cases can, and, I believe, should be treated entirely as a matter of semantic entailments of the lexical meaning of these verbs, not of their lexical semantic type, nor of their specified "control properties".

First, consider the assumption that the meaning of seem has a single, propositional argument. This assumption must be due to the fact that so-called raising sentences with seem are (approximately) paraphrasable with that-clauses such as (62):

(62) It seems that Mary won.

However, as Sag and Klein themselves recognize, a propositional-argument seem and a subject-and-infinitive-argument seem are in principle completely interdefinable, as might be made explicit by a "meaning postulate" (63):

(63) $\forall p \forall P \square (\text{seem}_1'(\wedge P(p)) \leftrightarrow \text{seem}_2'(P)(p))$

This means that any conceivable semantic entailment that we would need to capture with "propositional" seem (or seem₁) could equivalently be captured with "individual and property" seem (or seem₂), and conversely. Thus there is no real reason for taking one or the other as the more basic.

Similarly with Equi verbs like try, a predicate try₂ that takes only an individual and a VP meaning as argument is interdefinable with a predicate try₁ that takes an individual subject and a "like-subject" propositional complement as arguments: cf. meaning postulate (64):⁶

(64) $\forall p \forall P \square [p\{\hat{x} \text{ try}_1'(P(x*))\}(x*) \leftrightarrow \text{try}_2'(P)(p)]$

So once again, there is really no semantic motivation for taking either as more basic.

In the case of try, the intuitive notion that this verb MUST be analyzed semantically in terms of an "invisible" embedded subject for the complement verb seems to be a hard notion for linguists to rid themselves of, so let me further explicate this point by reference to an analogous situation. In the early 1970's George Lakoff observed that active and passive sentences with the adverb willingly differed in their possible interpretations, as (65) versus (66) indicate:

(65) The doctor willingly examined John.

(66) John was willingly examined the doctor.

In order to explain this so-called "passive willingly" reading of (66), Lakoff (1970) assumed that willingly is a semantic predicate which has its own subject in underlying structure, independently of the subject of the main verb. This subject would be the same as that of the main verb in (65) but can be the same as the surface subject in (66). Thus Lakoff proposed that these examples have semantic structures (67) and (68) respectively:

(67) willingly'(the doctor examine John)(the doctor')

(68) willingly'(the doctor examine John)(John')

However, the well-known predicate-modifier analysis of adverbs of Stalnaker and Thomason (1973) showed that this complicated analysis was unnecessary. By treating passive verb phrases as predicates in their own right (rather than deriving them from active sentences) and by treating willingly as a predicate modifier (a word that combines with a predicate to give a new predicate), the logical forms (69) and (70) suffice to describe all the semantic properties of these examples correctly:

- (69) willingly'(examine John')(the doctor)
 (70) willingly'(be examined by the doctor')(John)

The point to observe here is that, semantically, the logical type of willingly under the Stalnaker-Thomason analysis is exactly the same as that of try under the analysis I am defending, hence a "double" subject for try sentences is just as superfluous semantically as a "double" subject for willingly sentences. If we wanted to formally capture the fact that the sentence "John was willingly examined by the doctor" entails, say, "John was willing that the doctor examine him" then we could do so by means of the meaning postulate (71):

- (71) $\forall p \forall P \square [\text{willingly}'(P)(p) \rightarrow p\{\hat{x} \text{ be-willing-that}'(P(x^*))(x^*)\}]$

But by the same token we could also capture by a meaning postulate alone the fact that the sentence "John tried to win" entails "John intended that he win" i.e. by the postulate (72):

- (72) $\forall p \forall P \square [\text{try}'(P)(p) \rightarrow p\{\hat{x} \text{ intend-that}'(P(x^*))(x^*)\}]$

The point is, there is enough "information" in the formula on the left side of the conditional in both cases to be able to describe all necessary entailments as artifacts of the lexical meaning if willingly or try respectively.

Now it might be supposed that there is in fact motivation for taking the lexical logical types of Equi and Raising to be as Klein and Sag and others have taken them to be because their analysis would obviate the need for separate lexical entries to relate the seem that takes raising to the seem that takes that-clauses, or to relate the persuade that occurs in (73a) to the persuade that occurs in (73b).

- (73) a. John persuaded Mary to be present.
 b. John persuaded Mary that she should be present.

However, this is not so, for three reasons. First, this consideration still does not in itself determine which of the two logical types that must be related is the more basic, e.g. does not give us reason to say that propositional-argument seem is more basic than "raising" seem. Second, as Klein and Sag themselves observe, there are actually additional idiosyncratic differences in the meanings of many verbs from one subcategorization frame to another. For example, to get a paraphrase of (73a) in a structure with a full complement clause as well as direct object, we need to add a modal should in the complement (cf. (73b)), and even this is not quite a paraphrase of (73a), as Klein and Sag note. So even if the verbs are treated as having the same logical type in the two cases, the double lexical entries are needed anyway to capture these further differences in meaning. Third, there are some Subject Raising verbs, like tend, which have no counterpart with a that-clause, so with such verbs there is no motivation at all from such considerations for having the meaning of the verb represented as a predicate of propositions. The same point can be made for object-Equi verbs like force, which likewise cannot be paraphrased in English with a full complement clause.

It is commonly supposed, of course, that there are also syntactic differences between Equi verbs and Raising verbs--specifically, that Raising but not Equi verbs permit dummy subjects or objects such as the it of "Extraposition" and there--and that this difference is to be explained either by deriving Equi and Raising sentences from different deep structures or else explained by a difference in the grammatical relations or compositional semantic structures assigned to these two classes of verbs. Since the analysis I am defending here posits no such difference, this difference in the distribution of dummies like there and it has often been viewed as a significant problem for the categorial analysis (as it was for Montague's original analyses).

However, there is a difference in the lexical meanings of Equi and Raising Verbs whose significance has not been fully appreciated. To the best of my knowledge, every Equi verb has what used to be called "selectional restrictions" on its controlling NP, while every Raising verb has no such restrictions on the corresponding surface NPs. I take it it is now universally agreed that the proper way to describe selectional restrictions is that these are entailments, or conventional implicatures, of the meanings of verbs with regard to their arguments. Thus the anomaly of (74)

- (74) a. ?The proposition tried to be true.
b. ?Water tries to consist of hydrogen and oxygen.

is to be explained by the assumption that the verb try conventionally implicates (or entails and conventionally implicates) that its subject is a sentient being capable of volition.

Now it certainly can be claimed to follow from the classical transformational analysis of Raising verbs that there should be no such selectional restrictions applying to the "raised" NP, and if selectional restrictions are semantic in origin, the same can be said to be true of analyses in which Raising verbs are assigned a propositional argument, rather than an individual argument, in semantic structure. On the other hand, it is an accident, according to these analyses, that all Equi verbs do have such selectional restrictions. After all, not all argument positions of all verbs have any selectional restrictions at all.

What I want to suggest here is that the presence of a selectional restriction for its NP argument may be the only thing that distinguishes Equi from Raising verbs; the difference in dummy NP behavior can be shown to follow from this alone.⁷

In particular, this result will follow if we adopt what has been called an "ugly object" analysis of there-insertion sentences.⁸ By this I mean an analysis in which the word there is treated as a kind of NP and is assigned a denotation just like all other NPs are; the difference is that this denotation is a so-called "ugly object," an entity that is quite different from other NP denotations in the universe of discourse. The semantic rules are then set up in such a way that predicates of existential sentences, such as be a unicorn in the garden, are given an interpretation in which their subject will play a vacuous role. Just to illustrate one way of carrying this out, we might arrange the rules so that the phrase be a unicorn in the garden is translated with vacuous lambda abstraction for its subject argument, as in (75)

(75) denotation of be a unicorn in the garden:

$$\lambda p [\exists x [\text{unicorn}'(x) \wedge \text{in-the-garden}'(x)]]$$

The sentence there is a unicorn in the garden will then translate directly into (76)

$$(76) \lambda p [\exists x [\text{unicorn}'(x) \wedge \text{in-the-garden}'(x)]](\text{ugly-object}')$$

but since the lambda binding is vacuous, this is equivalent to (77):

$$(77) \exists x [\text{unicorn}(x) \wedge \text{in-the-garden}'(x)]$$

Now it is a well-known consequence of such an "ugly object" analysis of the simple form that I have sketched that it would treat sentences like (78) as syntactically well-formed and at most only semantically deviant:

(78) ?There walks to the post office.

But more upsetting than this is that (79) would be generated with the same interpretation as there is a unicorn in the garden (in addition to its correct interpretation).

(79) John is a unicorn in the garden.

However, it is not hard to avoid these unwelcome consequences, if we wish to do so, by making use of a syntactic feature and the feature-passing conventions of GPSG to restrict the NP there to cooccurrence with existential VPs. (Such a treatment was once proposed by Gazdar in unpublished work.)

To carry this suggestion out, let us write the rule for forming existential VPs.

(80) If $\alpha \in \text{NP}$, $\beta \in \text{PP}$ or Adj , then $F_{80}(\alpha, \beta) \in \text{IV}_{[+\text{there}]}$, where

$$F_{80}(\alpha, \beta) = \text{be } \alpha \beta.$$

Translation: $\lambda p [\beta'(\wedge \alpha')]$

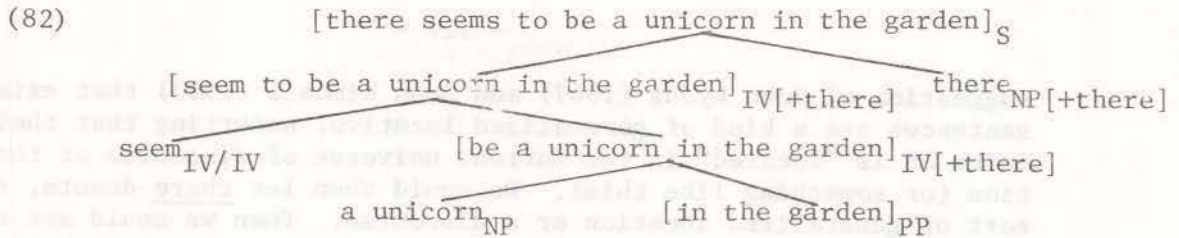
We next add a rule that combines the NP there with a VP bearing the feature $[+\text{there}]$ and thereby eliminates the "there" feature:

(81) If $\alpha \in \text{NP}_{[+\text{there}]}$, $\beta \in \text{IV}_{[+\text{there}]}$, then $F_{81}(\alpha, \beta) \in \text{S}_{[-\text{there}]}$,

(F_{81} is otherwise like the subject-predicate operation)

Translation: $\beta'(\wedge \alpha')$

I assume that when a VP with the feature $[+\text{there}]$ is combined with a VP complement verb such as seem, try, or expect, the syntactic feature conventions will pass this feature $[+\text{there}]$ up onto the higher VP that is formed. Thus an example like there seems to be a unicorn in the garden will be produced as in the analysis tree (82):



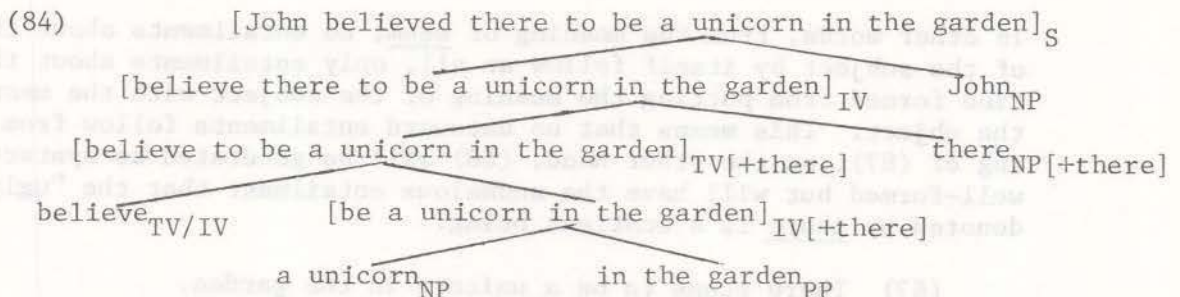
Note that the semantics of this sentence will be given correctly by the same lexical and compositional semantic interpretations needed for sentences where there does not occur, e.g. for John seems to have left.

Of course we still need to account for the appearance of there in direct object position in sentences like John believes there to be a unicorn in the garden. We could do this by adding a second rule parallel to (82) for object position, but since we have introduced the idea of rule schema generalizing over grammatical relations, we can here again take advantage of such schema to account for there in both positions by the same rule. The schema needed would be (83)

$$(83) \text{ If } \alpha \in \text{NP}_{[+there]}, \beta \in \text{V}_{n[+there]}, \text{ then } F_{83}(\alpha, \beta) \in \text{V}_{n-1[-there]}, \text{ where } n \leq 2.$$

Translation: $\beta'(\alpha')$

Where the value of n equals 2, this schema would lead to analyses trees such as (84):



(Note that the semantics again comes out right.) However, this schema as it stands is not exactly right, for the syntactic operation that (83) purports to generalize over really has to consist of two distinct operations, a subject-predicate operation that puts the NP to the left of the VP, and a verb-object operation that right-wraps the transitive VP around the object NP. In fact, what we should do is replace (83) with a meta-rule (in the sense of Gazdar 1982) generalized over grammatical relations, a rule that takes existing basic rules such as the subject-predicate and verb-object rules as input and gives derived rules just like these except that they mention the feature [+there]. But to save space, I omit this correction here.

In fact, once we have taken this step of restricting the syntactic distribution of there, it is not really necessary to treat the denotation of there as a vacuous "ugly object" at all. Suppose we agree with the

suggestion of John Lyons (1967) and John Kimball (1973) that existential sentences are a kind of generalized locative, asserting that their indefinite NP is "located" in the current universe of discourse of the conversation (or something like this). We could then let there denote, say, a sort of generalized location or a discourse. Then we could set up the semantics of the VP of an existential sentence, for example be a unicorn in the garden, to denote the property that locations or discourses have when they contain a unicorn that is in the garden. Whether we take this tack is not at issue here, however. (Of course, there are other aspects of the semantics of existential sentences which I have not attempted to discuss or incorporate into the translation of rule (81), but I don't think these are relevant to the issues at hand.)

Now let us finally return to the distinction between Equi and Raising verbs. By saying that Equi verbs such as try have a selectional restriction for subject, I mean that the essential characteristic of Equi verbs like try is that they have a conventional implicature and/or entailment approximately of the form of (85):

$$(85) \quad VP \text{ VP} \square [\text{try}'(P)(\phi) \rightarrow \text{sentient-being}'(\phi)]$$

By saying that Raising verbs have no such implicature, I mean that their essential characteristic is that any entailments that follow from the meaning of these verbs have the form of (86), where δ is some predicate of prepositions.

$$(86) \quad VP \text{ VP} \square [\text{seem}(P)(\phi) \rightarrow \delta(P\{\phi\})]$$

In other words, from the meaning of seem, no entailments about the meaning of the subject by itself follow at all, only entailments about the proposition formed from putting the meaning of the subject with the meaning of the object. This means that no untoward entailments follow from the meaning of (87); on the other hand, (88) will be generated as syntactically well-formed but will have the anomalous entailment that the "ugly" object denoted by there is a sentient being:

(87) There seems to be a unicorn in the garden.

(88) ?There tried to be a unicorn in the garden.

And I propose that nothing further needs to be said about the anomaly of (88) beyond this. To put it in different terms, the anomaly of (88) is claimed to arise for exactly the same reason as the anomaly of (74):

(74) a. ?The proposition tried to be true.

b. ?Water tries to consist of hydrogen and oxygen.

To be sure, this flies in the face of traditional wisdom that (88) is syntactically ill-formed while (74) is only semantically anomalous; however, both these examples are clearly deviant, and the history of syntactic and semantic theory has taught us that traditional assumptions about which anomalies are syntactic and which are semantic are often best revised.⁹

Before closing this paper, I should comment on the appeal to meaning postulates I have made in analyzing the entailments of the lexical meanings

of try and seem. One sometimes hears the objection that meaning postulates are ad hoc and that "with meaning postulates, one can do anything," as if their use added an unwelcome power that might not be present in certain other theories. This is false. First, there are conceivable restrictions on model-theoretic interpretation which cannot be captured by meaning postulates (Barbara Partee, personal communication), but more importantly, this objection rests on a misunderstanding of the role that meaning postulates play in model-theoretic semantics. It is an important feature of model-theoretic semantics that it leaves the values assigned to lexical meanings deliberately unspecified. To say that try is treated as a non-logical constant of type $\langle s, \langle s, \langle e, t \rangle \rangle, \langle e, t \rangle \rangle$ (or equivalently, to say that try translates into a constant try' of intensional logic of this type) is to say that its interpretation in any of the arbitrarily chosen models defined by the theory is some function in the set:¹⁰

$$\left(\left(\begin{pmatrix} \text{De} \\ \{0,1\} \end{pmatrix} \right) \begin{pmatrix} \{0,1\}^{\text{De}} \end{pmatrix} \right)^{I \times J} \quad I \times J$$

Of course, in the actual model for the English language we all speak, the meaning of try is just one particular function in this huge set, but the basic theory does not tell us which model this is. This approach (quite prudently) allows us to postpone specifying the actual semantics for try (and most other lexical meanings) while carefully circumscribing the range within which each meaning lies.¹¹ Meaning postulates are just one technical device for narrowing down the class of possible meanings for a lexical item (though not fixing it uniquely) in order that certain important classes of entailments from this item can be shown to be formally describable. If the actual model for English were some day precisely determined (and the unique semantic value for try were thereby fixed), then all (correct) meaning postulates involving try would be completely redundant, as these would simply be statements about entailments that this actual meaning had "already", as it were, determined.

If we now compare this treatment of lexical meaning with other kinds of semantic theories, e.g. the Lexical Functional Grammar of Kaplan and Bresnan (1981), we find that lexical meanings are also treated as unanalyzed primitives in these theories. Of course, any viable semantic theory must provide the means for specifying, sooner or later, more about these lexical meanings, whether one uses meaning postulates or some other device. To take a familiar example, it is an uncontroversial fact that a sentence Siegfried killed the dragon entails The dragon died, and anyone's theory must allow this kind of fact to be captured eventually. Moreover, it is now almost universally agreed that this fact should be attributed to the lexical meaning of kill rather than as an artifact of sentence semantics (as in Generative Semantics). It is hard to see (and certainly has not been shown) how a theory of lexical semantics would allow this kind of entailment to be captured and yet prohibit the kind of lexical entailment I have ascribed to try in (63) or to seem in (64). We could not for example prohibit a theory of lexical meaning from "manipulating grammatical relations" altogether, since in the case of the kill example, the NP the dragon is a

direct object in the original sentence but a subject in the entailed sentence. Thus there is no prima facie reason to believe that the account of lexical meaning in Lexical Functional Grammar (or any other theory) can in principle be more restrictive than the one I have appealed to in this paper.

Thus the central point of the argument in this section of the paper can be succinctly stated: it is one of simplicity. Any theory must be able to ascribe entailments to the meanings of lexical items. Since it appears that under any reasonable theory of lexical meaning the relevant entailments of Equi and Raising sentences can all be captured from the simple compositional semantic structures try'(win')(John') and seem'(win')(John'), there is simply no good argument for assuming the compositional semantics of these sentences is any more complicated than this. Of course, I have not presented any direct arguments that this compositional structure is not more complicated, and one cannot rule out the possibility that, for example, psycholinguistic experiments may someday show that the status of John as the subject of win in John tried to win is more "psychologically real" than the status of the dragon as the subject of die in Siegfried killed the dragon or of John as the subject of is willing in (66). But until such evidence has been presented, it seems reasonable to place the burden of proof on those who would advocate the more complicated compositional analysis. In defending a lexical reanalysis of the passive and other such transformations, Bresnan (1978) once speculated that "it is easier for us to look something up than to compute it." If this speculation is correct, then a purely lexical account of the "control properties" of Equi and Raising verbs is to be preferred, since it is perfectly feasible and simplifies compositional (i.e. "computed") semantics. While the account of dummy NPs that I have included to accompany this analysis may well be improved upon, or completely supplanted, the much more basic issue raised by the analysis of Equi and Raising verbs presented here is, I believe, one that any compositional theory of semantics cannot ignore.

Footnotes

*This paper was presented at a conference on grammatical relations at Harvard University on December 12, 1981. It will also appear in the proceedings of this conference, edited by Annie Zaenen and distributed by the Indiana University Linguistics Club.

¹The role of translation into intensional logic in Montague Grammar must not be misunderstood: this translation step is primarily for the convenience of the users of the theory and could be by-passed if desired. It is only the model-theoretic interpretation of English resulting indirectly from this translation step which is ultimately of importance to the theory.

²I do mean to imply that so-called thematic relations (Agent, Patient, Goal, etc.) play no role in natural languages whatsoever. It is well-known that there is an early stage of language acquisition at which children in effect rely on such relations rather than grammatical morphemes to interpret sentences (i.e. at that stage at which they may interpret The man ate the meat and The man was eaten by the meat as synonymous), and certain aphasics who have lost the ability to process syntactic structure appear to do so as well (Zurif and Blumstein 1978). Rather,

I mean simply that the full grammatical system of normal "adult" languages I am acquainted with seems to be describable in the most natural and simple way without appeal to such thematic relations. Evidence may be eventually forthcoming that an appeal to thematic relations in grammar is needed in some way as well, but I do not believe this need has been clearly demonstrated yet. Also, the existence of "true" or "deep" ergative languages such as Dyirbal and the simplicity with which they can be described in the present framework (Dowty 1982, Schmerling 1979, Trechsel 1981) shows that such thematic relations do not correlate with grammatical relations in a language-universal way at all.

³ Even if we somehow reconciled the claim that there can be two direct objects in a clause with the categorial analysis, it would not be obvious how to make sense out of the semantics of such an analysis. This is because the argument hierarchy of a verb, i.e. its grammatical relations, is the only means for determining which NP is which argument of the verb. (And unlike the Relation Grammar, I cannot appeal to an underlying stratum of the derivation to distinguish the two, for there is only one stratum of GR in the categorial account.) Nevertheless, a sentence such as John gave Mary the book is not in any way vague or ambiguous as to the interpretation of these two objects (as we might expect it to be in the categorial theory if both these NPs literally bore the same grammatical relation); rather, it clearly means that John gave the book to Mary, not that John gave Mary to the book.

⁴ An alternative analysis of impersonal passives has been proposed by Perlmutter (1978), involving the Un-Accusative Hypothesis (UAH) and the One-Advancement Exclusiveness Law (IAEX). Though I do not have anything to say about many of the facts about impersonal passives supposedly captured by this analysis, I will comment on three points. First, the UAH/IAEX analysis requires that impersonal passives have at some stage a dummy DO NP in addition to their underlying subject, this NP being advanced to subject by Passive. However, I see no independent syntactic motivation for an intermediate-stage DO in impersonal passives, nor any semantic motivation for this NP; as mentioned above, moreover, this dummy is not really motivated as even a surface subject in German and Turkish. Given the methodological assumptions with which I began--that syntactic and semantic analysis need not and should not depart from surface syntactic form unnecessarily--it is clearly desirable to dispense with this intermediate dummy. Secondly, while it is problematic enough that Perlmutter admits that the two "universal" classes of predicates posited by the UAH (i.e. "unergatives" vs. "unaccusatives") are not semantically characterizable in the same way in all languages, it is even worse that Nerbonne (this volume) has observed one language, Lithuanian, in which impersonal passives can be formed with verbs of all of the six semantic types explicitly characterized as "unaccusatives" by Perlmutter. Further examples of "unaccusative" impersonal passives have been pointed out in Irish (Nerbonne, personal communication) and in Arabic (Fuller, in preparation). Thus the prediction of the UAH/IAEX analysis of impersonal passives is either wrong in the case of these languages, or else the UAH is empirically vacuous as a universal since there would have to be at least one language, Lithuanian, which has virtually (or absolutely) no unaccusative predicates. There may well be many languages in which unaccusative predicates do not form impersonal passives, but this generalization can be described in

the categorial analysis simply by making it a conventional implicature of the impersonal passive rule that the action denoted is not a voluntary action of a human agent (or an involuntary bodily process); cf. Nerbonne (this volume). Of course, it would not follow from anything else in this theory that such a restriction should hold, but since it is not a truly universal fact about languages that impersonal passives are restricted in this way, this is not a very damaging objection. Thirdly, Brian Joseph has pointed out to me that the predictions made by this dummy analysis of impersonal passives with respect to unaccusatives only hold if the LAEX is valid. In fact, apparent counterexamples to the LAEX have been noted by Nerbonne, Gerdtz (1980), and perhaps elsewhere. If the LAEX is abandoned, then the Lithuanian, Irish and Arabic data are not a problem for the UAH per se, since the UAH and dummy analysis of impersonals now make no predictions about unaccusatives.

⁵When I say no motivation, I mean of course no motivation other than the theoretical assumption of Relational Grammar that an NP that is benefactive in meaning must necessarily not be a DO in the lowest stratum; as I have said, I see no necessity for saying that grammatical relations are universally semantically characterizable in terms like agent, patient or benefactive.

⁶This same point about try is made in Dowty, Wall and Peters (1981), pp. 235-236.

⁷This suggestion dates from a letter I wrote to Richmond Thomason in 1975, though I did not develop the analysis in detail at that time.

⁸Though "ugly object" analyses of dummy NPs have been widely discussed (the term is due to Lauri Karttunen, I believe), the only published example of such an analysis that I know of is Sag (1982); his treatment differs in a number of ways from that sketched below, however.

⁹If it is objected that (88) sounds more anomalous than (74), and an explanation is wanted, I can offer this: Of all the real-world entities that there are, the question of which entities have the ability to "try" to do things is more of a synthetic than analytic fact, and we can imagine with some effort, say, science fiction stories in which some inanimate things like propositions might have the attributes necessary to be able to "try" things. But the semantics of the existential construction is a res sui generis; we do not predicate anything of the entity or situation denoted by "there" except in existential sentences, and it is hard to imagine the semantics of such sentences being different without departing radically from the English language. This may also account for the subtle intuition that in trying to make sense out of an anomalous sentence such as There tried to be a unicorn in the garden, we are more likely to try to imagine try as a Raising verb than to interpret there as having a sentient denotation; it has been observed, after all, that verbs of English have often shifted historically from the Equi to the Raising class (Ard, 1977).

¹⁰For an explanation of this notation, see Dowty, Wall and Peters (1981).

¹¹For a lengthy excursus into the possibilities for describing word meaning in model-theoretic semantics, see Dowty (1979).

References

- Ard, John. (1977) Raising and Word Order in Diachronic Syntax, distributed by the Indiana University Linguistics Club.
- Bach, Emmon. (1980) "In Defense of Passive," Linguistics and Philosophy 3.3.297-341.
- Bach, Emmon. (1982) "Temporal Relations and Control," in G. Pullum and P. Jacobson (eds.), On the Nature of Syntactic Representation. Dordrecht: D. Reidel.
- Brame, Michael K. (1978) Base Generated Syntax. Seattle: Noit Amrofer.
- Bresnan, Joan W. (1978) "A Realistic Transformational Grammar," in M. Halle, J. Bresnan and G. Miller (eds.), Linguistic Theory and Psychological Reality. Cambridge, MA: MIT Press, 1-59.
- Curme, G. (1922) Grammar of the German Language. London: MacMillan.
- Dowty, David R. (1975) "Toward a Theory of Word Formation for Montague Grammar," in S. Schmerling (ed.), Texas Linguistic Forum 2, University of Texas Department of Linguistics, 69-96.
- Dowty, David R. (1978) "Lexically Governed Transformations as Lexical Rules in a Montague Grammar," Linguistic Inquiry 9.3.393-426.
- Dowty, David R. (1979) Word Meaning and Montague Grammar. Dordrecht: D. Reidel.
- Dowty, David R. (1982) "Grammatical Relations and Montague Grammar," in G. Pullum and P. Jacobson (eds.), On the Nature of Syntactic Representation. Dordrecht: D. Reidel, 79-130.
- Dowty, David R., Robert E. Wall, and Stanley Peters. (1981) Introduction to Montague Semantics. Dordrecht: Reidel.
- Fuller, Douglas. (in preparation) A Formal Analysis of the Classical Arabic Verbal System. OSU Ph.D. dissertation.
- Gazdar, Gerald and Ivan Sag. (1981) "Passive and Reflexives in Phrase Structure Grammar," in J. A. G. Groenendijk, T. M. V. Janssen and M. B. V. Stokhof (eds.), Formal Methods in the Study of Language, Part 1.131-152.
- Gazdar, Gerald. (1982) "Phrase Structure Grammar," in G. Pullum and P. Jacobson (eds.), On the Nature of Syntactic Representation. Dordrecht: Reidel.
- Gerdt, D. (1980) "Causal to Object Advancement in Halkomelem," CLS 16, 83-101.
- Jacobson, Pauline. (1981) "Comments on David Perlmutter's paper at the 1981 Annual Meeting of the Linguistic Society of America."
- Kaplan, Ronald M. and Joan W. Bresnan. (1981) Lexical-Functional Grammar: A Formal System for Grammatical Representation. MIT Center for Cognitive Science Occasional Paper # 13.
- Keenan, Edward and Bernard Comrie. (1977) "Noun Phrase Accessibility and Universal Grammar," Linguistic Inquiry 8.1.62-100.
- Keenan, Edward and Judith Gary. (1977) "On Collapsing Grammatical Relations in Universal Grammar," in P. Cole and J. Sadock (eds.), Syntax and Semantics Vol. 8: Grammatical Relations. New York: Academic Press, 83-120.
- Klein, Ewan and Ivan Sag. (1981) "Semantic Type and Control," paper read at the 1981 Annual Meeting of the Linguistic Society of America.
- Lakoff, George. (1970) "Adverbs and Opacity," distributed by the Indiana University Linguistics Club.

- Lyons, J. (1967) "A Note on Possessive, Locative and Existential Sentences," Foundations of Language 3.390-96.
- Montague, Richard. (1973) "The Proper Treatment of Quantification in Ordinary English," in J. Hintikka, J. Moravcsik, and P. Suppes (eds.), Approaches to Natural Languages. Dordrecht: Reidel.
- Nerbonne, John. (1982) "The German Impersonal Passive: A Non-Structure-Preserving Lexical Rule," paper read at the First West Coast Conference on Formal Semantics.
- Nerbonne, John. (This volume) "Some Passives Not Characterized by Universal Rules: Subjectless Impersonals," OSU WPL 26.59-92.
- Partee, Barbara. (1979) "Montague Grammar and the Well-Formedness Constraint," in F. Heny and H. Schnelle (eds.), Syntax and Semantics Vol. 10: Selections from the Third Groningen Round Table. New York: Academic Press, 275-313.
- Perlmutter, David and Paul Postal. (1977) "Toward a Universal Characterization of Passivization," in Whistler et al. (eds.), Proceedings of the Third Annual Meeting of the Berkeley Linguistic Society, 393-417.
- Perlmutter, David. (1978) "Impersonal Passives and the Unaccusative Hypothesis," in Proceedings of the Berkeley Linguistic Society, Vol. 4.
- Quine, Willard V. O. (1966) "Variables Explained Away," in W. V. O. Quine, Selected Logic Papers, New York: Random House, 227-243.
- Sag, Ivan. (1982) "A Semantic Theory of 'NP Movement' Dependencies," in G. Pullum and P. Jacobson (eds.), On the Nature of Syntactic Representation. Dordrecht: Reidel.
- Schmerling, Susan. (1979) "A Categorical Analysis of Dyirbal Ergativity," in C. Smith and S. Schmerling (eds.), Texas Linguistic Forum 13, 96-112.
- Schoenfinkel, Moses. (1924) "Ueber die Bausteine der mathematischen Logik," Mathematische Annalen 92.305-316.
- Seiter, William J. (1979) "Instrumental Advancement in Niuean," Linguistic Inquiry 10.4.595-622.
- Stalnaker, Robert and Richmond Thomason. (1973) "A Semantic Theory of Adverbs," Linguistic Inquiry 4.2.195-220.
- Trechsel, Frank P. (1981) A Categorical Treatment of Quichean (Mayan) Ergativity. University of Texas Dissertation.
- Trithart, Lee. (1979) "Topicality: An Alternative to the Relational View of Bantu Passive," Studies in African Linguistics 10.1.1-30.
- von Stechow, A. (1979) "Deutsche Wortstellung und Montague-Grammatik," in J. Meisel and Pam, Linear Order and Generative Theory. Amsterdam: John Benjamins (Current Issues in Linguistic Theory vol. 7).
- Zurif, Edgar B. and Sheila E. Blumstein. (1978) "Language and the Brain," in M. Halle, J. Bresnan and G. Miller (eds.), Linguistic Theory and Psychological Reality, Cambridge, MA: MIT Press, 229-246.